FAST FORTRAN PROCESSOR DIAGNOSTIC

reference manual

For HP 1000 M-/E-Series Computers

ABSOLUTE BINARY PROGRAMS 12977-16004 and 12977-16005
DATE CODE 1822

CONTENTS

ILLUSTRATIONS

TABLES

INTRODUCTION

1-1. GENERAL

This diagnostic program confirms proper operation of the HP 12977A and HP 13306A Fast FORTRAN Processors (FFP) for HP 1000 M-Series and E-Series Computers respectively. The FFP consists of 25 library subroutines implemented by microcode on ROM chips.

1-2. REQUIRED HARDWARE

The following hardware is required:

a. HP 1000 M-/E-Series Computer with a minimum 4K memory.

b. HP 12977 Fast FORTRAN Processor for 2105/2108/2112
   HP 13306 Fast FORTRAN Processor for 2109/2113

c. Console device for message reporting (recommended but not required).

d. Loading device for loading the diagnostic program.

e. Any standard I/O interface board is required for interrupt checks, which are made for the .XADD, .XSUB, .XMPY, and .XDIV subroutines.

1-3. SOFTWARE REQUIREMENTS

The following software is required:

a. The Diagnostic Configurator (part numbers listed below) is used for equipment configuration and as a console device driver.

   Absolute binary program, part no. 24296-60001
   Reference Manual, part no. 02100-90157

b. Fast FORTRAN Processor Diagnostic

   Absolute binary program 1, part no. 12977-16004
   Absolute binary program 2, part no. 12977-16005
   Reference Manual, part no. 12977-90002

The diagnostic serial number (DSN) is contained in memory location 126 (octal) of the program. The DSN for this program is 101213 (octal) for diagnostic number 1 and 101114 (octal) for diagnostic number 2.

2-1. ORGANIZATION

This diagnostic program is divided into two parts due to its size. Part one consists of 12 tests, part two consists of 13 tests, plus each has a Control section and an Initialization section. The Initialization and Control sections accept the select code of the I/O interface board which is used to test the interruptible instructions. The tests, which are called into execution by the Control section as sequential or selectable subroutines, are listed below.

PROGRAM 1 (PART NO. 12977-16004)		PROGRAM 2 (PART NO. 12977-16005)	
TEST (IN OCTAL)	FUNCTIONS	TEST (IN OCTAL)	FUNCTIONS
0	"..MAP" Test	0	".GOTO" Test
1	"SNGL" Test	1	".ENTR" Test
2	"DBLE" Test	2	".ENTP" Test
3	".DFER" Test	3	"$SETP" Test
4	".XFER" Test	4	"XADD" Test
5	"PWR2" Test	5	"XSUB" Test
6	".PACK" Test	6	"XMPY" Test
7	".FLUN" Test	7	".XADD" Test
10	".XPAK" Test	10	".XSUB" Test
11	".XCOM" Test	11	".XMPY" Test
12	"..DCM" Test	12	".XDIV" Test
13	"DDINT" Test	13	"XDIV" Test
14	".CFER" Test		

2-2. TEST CONTROL AND EXECUTION

The program outputs a title message to the console device (if present) for operator information and then executes the tests according to the options selected on the Switch Register. The control section primarily checks Switch Register bits 15, 13 and 12.

The Control section keeps count of the number of passes that have been completed and will output the pass count at the completion of each pass (if Switch Register bit 10 is clear). The count will be reset only if the program is restarted.

Test sections are executed one after another in each diagnostic pass. User selection or default will determine which test sections will be executed. Refer to paragraph 2-3.

2-3. SELECTION OF TEST BY OPERATOR

The operator has the capability to select his own tests or sequence of tests with the help of Switch Register bit 9. Paragraph 3-4 outlines the test selection.

2-4.   MESSAGE REPORTING

There are two types of messages: error and information. Error messages are used to inform the operator of a failure of the interface to respond to a given control or sequence. Information messages are used to inform the operator of the progress of the diagnostic or to instruct the operator to perform some operation related to the FFP functions. In this case, an associated halt will occur to allow the operator time to perform the function; the operator must then press RUN.

If a console device is used, the printed message will be preceded by an E (error) or H (information) and a number (in octal). The number is also related to the halt code when a console device is not available.

Example — Error with halt

    Message: E121 OVERFLOW NOT SET
    Halt Code: 106021 (T-register)

Example — Information only

    Message: H110 ..MAP TEST
    Halt Code: None

Error messages can be suppressed by setting Switch Register bit 11 and error halts can be suppressed by setting Switch Register bit 14. This is useful when looping on a single section that has several errors.

Information messages are suppressed by setting Switch Register bit 10. When Switch Register bit 12 is set, the tests that are selected will be repeated.

2.5.   LIMITATIONS

All microcode failure types are detected by the diagnostic except:

a. If the microcode does not return control to the diagnostic program, test validity cannot be assured. This situation results in the cessation of messages to the operator. Pressing HALT on the computer will usually *not* halt the computer. The only remedy is to turn the power off and reload the diagnostic program.

b. If the microcode returns control to the diagnostic program but not to the proper location, the results are meaningless. Reload the diagnostic program to continue the test.

3-1. OPERATING PROCEDURES

A flowchart of the operating procedure is provided in figure 3-1.

3-2. RUNNING THE DIAGNOSTIC

The program will execute the diagnostic according to options selected in the Switch Register. At the completion of each pass of the diagnostic, the pass count is printed on the console device for operator information. If Switch Register bit 12 was not selected (set), the computer will halt with 102077 (octal) in the T-register. At this point, the A-register contains the pass count. To run another pass, press RUN.

3-3. RESTARTING

The program can be restarted by setting the P-register to 2000 (octal). Select Switch Register options shown in table 3-2 and press RUN.

If a trap cell halt occurs (106077 octal), the user must determine the cause of the interrupt or transfer of control to the location shown in the M-register. The program may need to be reloaded to continue.

3-4. TEST SELECTION BY OPERATOR

The Control section of the diagnostic provides the operator with a method to select his own test, or sequence of tests, to be run. The operator sets Switch Register bit 9 to indicate the desire to make a selection. The computer will come to a halt 102075 (octal) to indicate that it is ready for selection. If the program is running, the current test will be completed and then the program will halt. The operator then loads the A-register with the tests desired. A-register bit 0 represents Test 00, bit 1 represents Test 01, and so on through bit 11 which represents Test 13. (Refer to table 3-3.) The operator must then clear Switch Register bit 9 and press RUN. The operator's selection will then be run. If the operator clears all bits, the standard sequence will be run.

All E-Series FFPs with part nos. 5090-0589 through 5090-0591 and 13306-80013 through 13306-80018, contain a routine which is not present in M-Series FFPs, or E-Series FFPs with earlier part nos. This routine, .CFER, is tested by TST 14 in Program 1. If an attempt is made to execute TST 14 in a computer without .CFER, an error halt, (halt 107031), and a displayed message will result. If the default tests are executed, TST 14 will be included only if the routine .CFER is present in the FFP. To check for this routine, examine the A-Register when the HLT 74 occurs during configuration, if bit 12 is set, then .CFER is present.
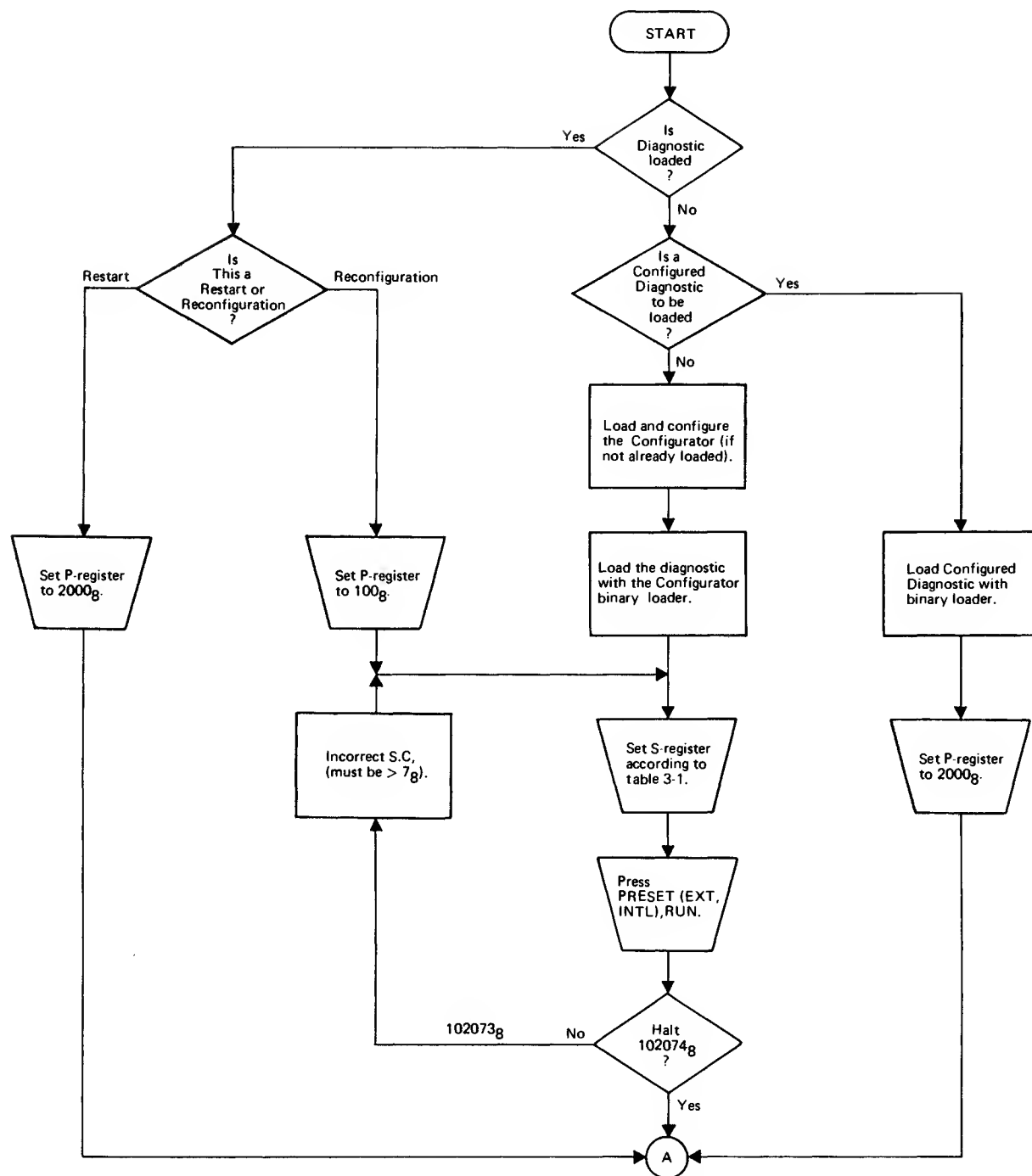
Figure 3-1. Operating Procedure Flowchart (Sheet 1 of 2)
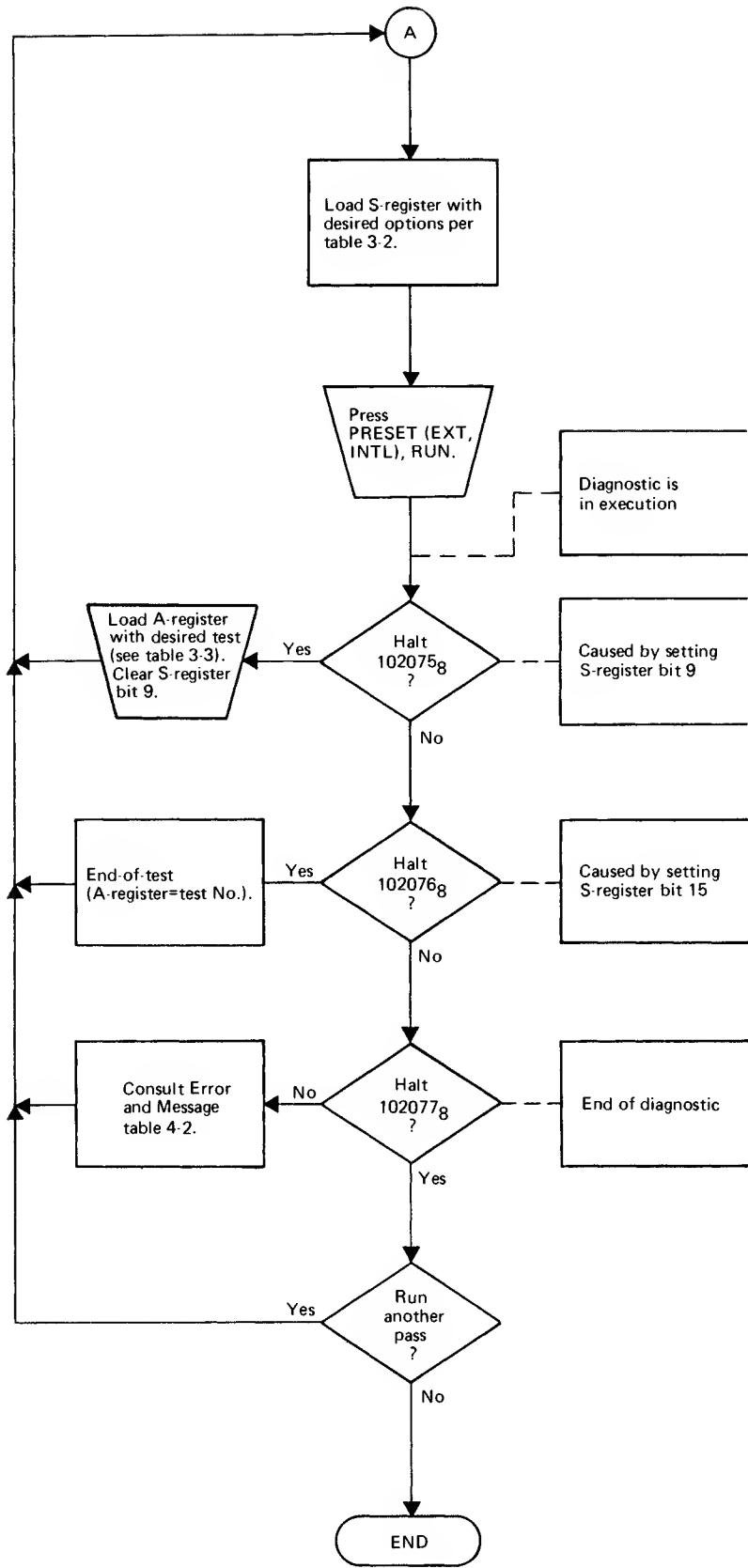
Figure 3-1. Operating Procedure Flowchart (Sheet 2 of 2)

Table 3-1. Initial Switch Register Settings

BIT	MEANING IF SET
5-0	Select Code of any standard* I/O device used by interruptible tests.
15-6	Reserved
*Standard I/O implies that the interface will respond to the assigned meaning of the I/O instructions and will interrupt when the Control and Flag are set and the interrupt system is enabled.	

Table 3-2. Switch Register Options

BIT	MEANING IF SET
8-0	Reserved.
9	Abort current diagnostic execution and halt (102075); user may specify a new group of tests in the A-register (see table 3-3), clear bit 9, and then press RUN.
10	Suppress non-error messages.
11	Suppress error messages.
12	Repeat all selected tests after diagnostic run is complete without halting. Message "PASS XXXXXX" will be output before looping unless bit 10 is set or console is not present. Also those tests requiring operator intervention will be suppressed.
13	Repeat last test executed (loop on test).
14	Suppress error halts.
15	Halt (102076) at the end of each test; the A-register will contain the test number in octal.

Table 3-3. Test Selection by Operator

PROGRAM 1 (PART NO. 12977-16004)			PROGRAM 2 (PART NO. 12977-16005)		
A-REG	TEST (IN OCTAL)	FUNCTIONS	A-REG	TEST (IN OCTAL)	FUNCTIONS
0	0	"..MAP" Test	0	0	".GOTO" Test
1	1	"SNGL" Test	1	1	".ENTR" Test
2	2	"DBLE" Test	2	2	".ENTP" Test
3	3	".DFER" Test	3	3	"$SETP" Test
4	4	".XFER" Test	4	4	"XADD" Test
5	5	"PWR2" Test	5	5	"XSUB" Test
6	6	".PACK" Test	6	6	"XMPY" Test
7	7	".FLUN" Test	7	7	".XADD" Test
8	10	".XPAK" Test	8	10	".XSUB" Test
9	11	".XCOM" Test	9	11	".XMPY" Test
10	12	"..DCM" Test	10	12	".XDIV" Test
11	13	"DDINT" Test	11	13	"XDIV" Test
12	14	".CFER" Test			
Note: If all bits of A-register are cleared, all 12, (or 13 if .CFER is present), tests will be executed.					

DIAGNOSTIC MESSAGES AND HALTS

The diagnostic communicates to the operator through the console, via a CPU halt, or both, based on configuration and switch register settings. Thus, messages consist of halt codes (T-register and A-register values) and/or output to the console.

4-1. HALT SUMMARY

Table 4-1 lists octal halt codes and their meanings.

Table 4-1. Halt Code Summary

HALT CODE	MEANING
102030-102060 106000-106063 103000-103021 107000-107024	Error (E) messages 30_8 to 221_8 described in table 4-2.
102066	Basic I/O test failure.
102073	Halt indicating select code input error during "Starting Up" procedure. Input valid select code; press RUN.
102074	Valid select code entry was made; make program option switch register setting and press RUN.
102075	Halt to allow test selection in A-register; make test selection and press RUN.
102076	End of test section halt; A-register holds test number just completed.
102077	Diagnostic completed; A-register holds octal number of passes completed.
106077	Trap cell halts stored in CPU memory locations 2_8 to 77_8; indicates hardware malfunction.
106070-106076	Refer to *Diagnostic Configurator Reference Manual* for these halts.

4-2. MESSAGE SUMMARY

Tables 4-2 and 4-3 list diagnostic messages in diagnostic message order number diagnostic program 1 and diagnostic program 2, respectively. The test that outputs each message is also indicated in the same table. "TC" refers to the Test Control program; otherwise, the numbers refer to the test number.

Table 4-2. Error Information Messages and Halt Codes for Diagnostic Program 1

HALT CODE	TEST SECTION	MESSAGE	COMMENTS
102073	TC	None	Invalid S.C. entered during configuration. Valid select codes are 10-77$_8$. Load S-register bits 5-0 with valid S.C. and press RUN.
102074	TC	None	Halt to allow input of the S.C. of the interface board to be used in the interruptibility tests.
102075	TC	None	Halt to allow test selection.
102076	TC	None	End of test section; A-register holds test number just completed.
102077	TC	PASS XXXXXX	Diagnostic run completed; A-register holds octal number of passes completed.
106077	TC	None	Halt stored in location 2-77 to trap interrupts which may occur unexpectedly because of hardware malfunctions. M-register contains the select code of the I/O slot which interrupted. Diagnostic may be partially destroyed if halt occurs. The program may have to be reloaded; the problem should be corrected before proceeding.
106070- 106076	Diag. Config.	None	See *Diagnostic Configurator Reference Manual* for meanings of these halts.
106010	0	E110 DATA ERROR ACT *xxxxxx* EXP *yyyyyy*	See Note 1.
106020	1	E120 DATA ERROR ACT *xxxxxx xxxxxx* EXP *yyyyyy yyyyyy*	See Note 2.
106021	1	E121 OVERFLOW NOT SET	
106023	1	E123 OVERFLOW SET	
106030	2	E130 DATA ERROR ACT *xxxxxx xxxxxx xxxxxx* EXP *yyyyyy yyyyyy yyyyyy*	See Note 3.
103010	3	E210 FAILED	
103011	3	E211 NO CHECK ON MEM PROT VIOLATION	
103020	4	E220 FAILED	
103030	5	E230 DATA ERROR ACT *xxxxxx xxxxxx* EXP *yyyyyy yyyyyy*	See Note 2.
103040	6	E240 DATA ERROR ACT *xxxxxx xxxxxx* EXP *yyyyyy yyyyyy*	See Note 2.
103050	7	E250 DATA ERROR ACT *xxxxxx xxxxxx* EXP *yyyyyy yyyyyy*	See Note 2.

Table 4-2. Error Information Messages and Halt Codes for Diagnostic Program 1 (Continued)

HALT CODE	TEST SECTION	MESSAGE	COMMENTS
103060	10	E260 DATA ERROR ACT *xxxxxx xxxxxx xxxxxx* EXP *yyyyyy yyyyyy yyyyyy*	See Note 3.
107000	11	E300 DATA ERROR ACT *xxxxxx xxxxxx xxxxxx wwwwww* EXP *yyyyyy yyyyyy yyyyyy zzzzzz*	See Note 4.
107010	12	E310 DATA ERROR ACT *xxxxxx xxxxxx xxxxxx* EXP *yyyyyy yyyyyy yyyyyy*	See Note 3.
107020	13	E320 DATA ERROR ACT *xxxxxx xxxxxx xxxxxx* EXP *yyyyyy yyyyyy yyyyyy*	See Note 3.
107021	13	E321 NOT INTERRUPTIBLE	
107022	13	E322 P-REG NOT REST. ON INTERR	
107023	13	E323 A-REG NOT REST. ON INTERR	
107024	13	E324 B-REG NOT REST. ON INTERR	
NONE	TC	TEST xx	Message output before the first error message within a test section (xx=test number).
107030	14	E330 FAILED	
107031	14	E331 NO CHECK ON MEM. PROT. VIOLATION	

NOTES

1. The integer "*xxxxxx*" was returned instead of "*yyyyyy*". When the error halt occurs, the A-register contains "*xxxxxx*" while the B-register contains "*yyyyy*".

2. The single precision floating point number "*xxxxxx xxxxxx*" was returned instead of "*yyyyyy yyyyyy*". When the error halt occurs, the A- and B-register contain the first and second word, respectively, of the actual number.

   Pressing "RUN" will result in a halt 107000. Now, the A- and B-register contain the first word and second word, respectively, of the expected number.

3. The extended precision number "*xxxxxx xxxxxx xxxxxx*" was returned instead of "*yyyyyy yyyyyy yyyyyy*". When the error halt occurs, the A- and B-register will contain the first and second word, respectively, of the actual data.

   When "RUN" is pressed, a halt 107002 will occur. The A-register will contain the third word of the actual data. The B-register will be zero.

   Pressing "RUN" will cause a halt 107001. The A- and B-registers will contain the first and second word, respectively, of the expected data.

   When "RUN" is pressed again, a halt 107000 will result. The third word of the expected data will be in the A-register and the B-register will be zero.

4. The extended precision number "*xxxxxx xxxxxx xxxxxx*" and exponent adjustment "*wwwwww*" were returned instead of "*yyyyyy yyyyyy yyyyyy*" and "*zzzzzz*". When the error halt occurs, the A- and B-register will contain the first and second word, respectively, of the actual data.

   When "RUN" is pressed, a halt 107002 will occur. The A-register will contain the third word of the actual data; the actual exponent adjustment will be in the B-register.

   Pressing "RUN" will cause a halt 107001. The A- and B-registers will contain the first and second word, respectively, of the expected data.

   When "RUN" is pressed again, a halt 107000 will occur. The A-register will contain the third word of the expected data; the expected exponent adjustment will be in the B-register.

Table 4-3. Error Information Messages and Halt Codes for Diagnostic Program 2

HALT CODE	TEST SECTION	MESSAGE	COMMENTS
102073	TC	None	Invalid S.C. entered during configuration. Valid select codes are 10-77$_8$. Load S-register bits 5-0 with valid S.C. and press RUN.
102074	TC	None	Halt to allow input of the S.C. of the interface board to be used in the interruptibility tests.
102075	TC	None	Halt to allow test selection.
102076	TC	None	End of test section; A-register holds test number just completed.
102077	TC	PASS XXXXXX	Diagnostic run completed; A-register holds octal number of passes completed.
106077	TC	None	Halt stored in location 2-77 to trap interrupts which may occur unexpectedly because of hardware malfunctions. M-register contains the select code of the I/O slot which interrupted. Diagnostic may be partially destroyed if halt occurs. The program may have to be reloaded; the problem should be corrected before proceeding.
106070-106076	Diag. Config.	None	See *Diagnostic Configurator Reference Manual* for meanings of these halts.
102030	0	E030 FAILED FOR INDIRECT ADDRESSING	
102031	0	E031 FAILED FOR J=0	
102032	0	E032 FAILED FOR J=NEG	
102033	0	E033 FAILED FOR J>16	
102034	0	E034 FAILED FOR J=8	
102050	1	E050 FAILED FOR ACTUAL NR OF PARAM<ALLOWED NR	
102051	1	E051 FAILED FOR ACTUAL NR OF PARAM=ALLOWED NR	
102052	1	E052 FAILED FOR ACTUAL NR OF PARAM>ALLOWED NR	
102053	1	E053 NO CHECK ON MEM PROT VIOLATION	
102054	1	E054 RETURN ADDRESS NOT STORED IN CORRECT LOCATION	
102055	1	E055 RETURN ADDRESS NOT IN A-REG	
102056	1	E056 INCORRECT ADDR. IN B-REG	
102060	2	E060 FAILED FOR ACTUAL NR OF PARAM<ALLOWED NR	
106000	3	E100 A-REG. NOT=0 UPON RETURN	

Table 4-3. Error Information Messages and Halt Codes for Diagnostic Program 2 (Continued)

HALT CODE	TEST SECTION	MESSAGE	COMMENTS
106001	3	E101 B-REG. DOES NOT CONTAIN LAST ADDRESS +1 UPON RETURN	
106002	3	E102 INCORRECT VALUE STORED	
106003	3	E103 MORE LOCATIONS FILLED THAN REQUESTED	
106004	3	E104 NO CHECK ON MEM PROT VIOLATION	
106005	3	E105 NOT INTERRUPTIBLE	
106006	3	E106 P-REG NOT REST ON INTERR	
106007	3	E107 A-REG NOT REST ON INTERR	
106010	3	E110 B-REG NOT REST ON INTERR	
106011	3	E111 NOT INTERRUPTIBLE DURING PARAM. FETCH	
106012	3	E112 P-REG NOT RESTORED ON INTERR. DURING PARAM. FETCH	
106013	3	E113 A-REG NOT RESTORED ON INTERR. DURING PARAM. FETCH	
106014	3	E114 B-REG NOT RESTORED ON INTERR. DURING PARAM. FETCH	
106015	4	E115 DATA ERROR ACT xxxxxx xxxxxx xxxxxx EXP yyyyyy yyyyyy yyyyyy	See Note.
106025	5	E125 DATA ERROR ACT xxxxxx xxxxxx xxxxxx EXP yyyyyy yyyyyy yyyyyy	See Note.
106035	6	E135 DATA ERROR ACT xxxxxx xxxxxx xxxxxx EXP yyyyyy yyyyyy yyyyyy	See Note.
106040	7	E140 DATA ERROR ACT xxxxxx xxxxxx xxxxxx EXP yyyyyy yyyyyy yyyyyy	See Note.
106041	7	E141 OVERFLOW NOT SET	
106042	7	E142 NOT INTERRUPTIBLE	
106043	7	E143 OVERFLOW SET	
106044	7	E144 P-REG NOT REST. ON INTERR	
106045	7	E145 NO CHECK ON MEM PROT VIOLATION	
106050	10	E150 DATA ERROR ACT xxxxxx xxxxxx xxxxxx EXP yyyyyy yyyyyy yyyyyy	See Note.

Table 4-3. Error Information Messages and Halt Codes for Diagnostic Program 2 (Continued)

HALT CODE	TEST SECTION	MESSAGE	COMMENTS
106060	11	E160 DATA ERROR ACT *xxxxxx xxxxxx xxxxxx* EXP *yyyyyy yyyyyy yyyyyy*	See Note.
106062	11	E162 NOT INTERRUPTIBLE	
106063	11	E163 P-REG NOT REST. ON INTERR	
103000	12	E200 DATA ERROR ACT *xxxxxx xxxxxx xxxxxx* EXP *yyyyyy yyyyyy yyyyyy*	See Note.
103001	12	E201 OVERFLOW NOT SET	
103002	12	E202 NOT INTERRUPTIBLE	
103003	12	E203 P-REG NOT REST. ON INTERR	
103015	13	E215 DATA ERROR ACT *xxxxxx xxxxxx xxxxxx* EXP *yyyyyy yyyyyy yyyyyy*	See Note.
NONE	TC	TEST xx	Message output before the first error message within a test section (xx= test number).

NOTE

The extended precision number "*xxxxxx xxxxxx xxxxxx*" was returned instead of "*yyyyyy yyyyyy yyyyyy*". When the error halt occurs, the A- and B-register will contain the first and second word, respectively, of the actual data.

When "RUN" is pressed, a halt 107002 will occur. The A-register will contain the third word of the actual data. The B-register will be zero.

Pressing "RUN" will cause a halt 107001. The A- and B-registers will contain the first and second word, respectively, of the expected data.

When "RUN" is pressed again, a halt 107000 will result. The third word of the expected data will be in the A-register and the B-register will be zero.

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